a guide to the sky

1A. Cirrocumulus. When this high cloud forms, it can give the sky the appearance of wind blowing on a pond of white water. This cloud is often seen on the fringes of storms, and after a spell of fine weather, signals a change. *Boston, Massachusetts*

1B. Cirrus (uncinus). A cluster of ice crystals in the form of a hook or tuft forms the top of this ice cloud. The larger ice crystals, having fallen below the tuft in strands, are being left behind. *Plymouth, Massachusetts*

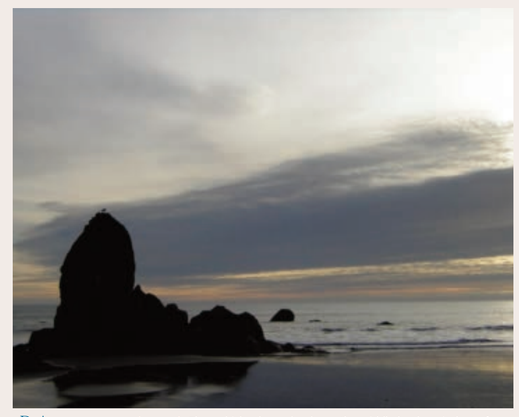
1C. Cirrus (spissatus). This is the only cirriform cloud that, by definition is thick enough to produce gray shading except those seen near sunrise and sunset. Sometimes in summer they are the remnants of Cumulonimbus anvils. *Near Sonoma, California*

1D. Cirrus (fibratus). These are patchy ice crystal clouds with gently curved or straight filaments. They are older versions of Cirrus clouds. By definition they are not thick enough to produce gray shading except when the sun is low in the sky. *Catalina, Arizona*

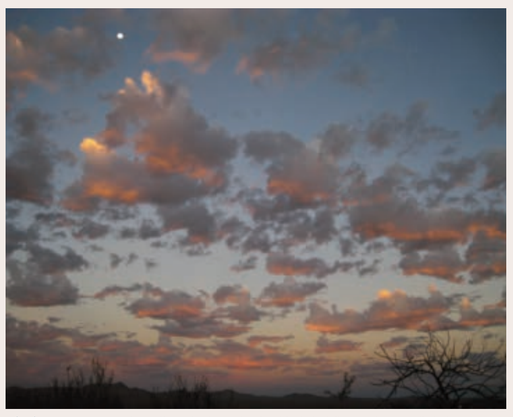
2A. Cirrostratus (nebulosus). This vellum-like ice cloud thickens (more than due to perspective) upwind to the west. In winter, rain or snow follows this scene about 70 percent of the time. *Seattle, Washington*

2B. Altostratus. Sunlight fades and brightens as the thicker (opacus) and thinner (translucidus) portions of this icy cloud move rapidly from the southwest. Rain or snow are likely to follow this scene within hours. *Catalina, Arizona*

2C. Altocumulus (perlucidus). This honeycombed ("perlucidus") layer cloud usually indicates that large areas (thousands of square km) are undergoing a gradual ascent brought about by an advancing trough and area of low pressure. *Catalina, Arizona*



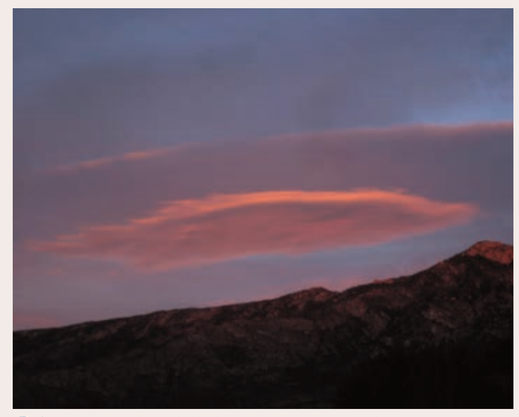
2D. Altocumulus (opacus). These thicker layer clouds are the middle-level equivalent of *Stratocumulus* clouds in structure and depth except that their bases are higher (here about 3-4 km AGL) and the elements comprising the layer smaller than those of *Stratocumulus*. *Port Orford, Oregon*



3A. Altocumulus (castellanus). These clouds with their delicate spires usually indicate that the atmosphere aloft is relatively warm and of tropical origin. Deeper clouds and showers may be in the offing. *Catalina, Arizona*

3B. Altocumulus. Strands of falling snow (referred to as "virga") extend far below these clouds before evaporating. Higher Cirrus can also be seen; the atmosphere is in gradual ascent and a storm approaches. *Westlake Village, California*

3C. Altocumulus (lenticularis). These clouds, ones that hover over the same location downwind of a mountain range or peak, often expanding and shrinking in minutes, indicate strong winds aloft. This cloud suggests that a trough and low are upstream and approaching. *Catalina, Arizona*

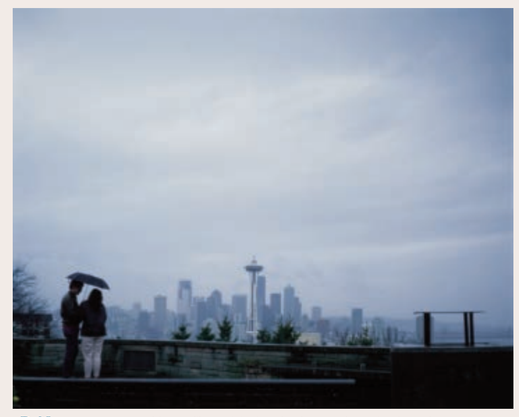


3D. Altocumulus (lenticularis). These droplet clouds in the lee of the Catalina Mountains hover over the next downwind range of mountains. They form when the winds aloft are strong, and the air is moistening. *Catalina, Arizona*

4A. Stratus (nebulosus). When *Stratus* is overhead, the sky is low, the air is damp, and hilltops are hidden. The lack of precipitation other than perhaps fine drizzle signals that it is a thin cloud, and not *Nimbostratus*. *Goat Rock, California*

4B. Stratocumulus (stratiformis). *Orographic Stratocumulus* clouds, about 0.5 to 1 km thick, top the Catalina Mountains following a snowstorm. These clouds, forced by the ascent of air over the mountains, may be the only clouds present in the sky at the very end of a storm. *Catalina, Arizona*

4C. Stratocumulus (stratiformis). Some widespread *Stratocumulus* clouds, such as those pictured here, are associated with storms, either on their peripheries, or under the rainy clouds themselves. If they are moving from the northwest and their bases are rising, it is a good sign that the storm is departing. *Chincoteague Island, Virginia*



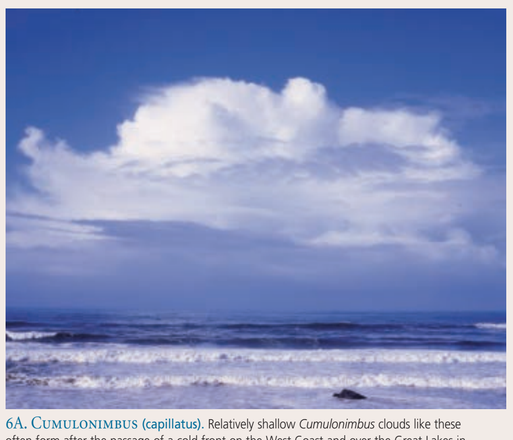
4D. Nimbostratus. This steadily precipitating cloud covers the entire sky and appears diffuse because cloud detail is obscured by falling precipitation. The appearance of ragged skies often signals cloud tops have lowered and the rain will end soon. *Seattle, Washington*

5A. Cumulus (fractus and humilis). These small clouds are strongly flattened at the top showing that a strong atmospheric stable layer will inhibit further growth. The smallest, shred-like clouds are referred to as Cumulus fractus. *Catalina, Arizona*

5B. Cumulus (mediocris and small congestus). These bulging, tightly packed turrets show no evidence in the early afternoon of flattening at cloud top and further growth into showers or thunderstorms is assured. *Puget Sound, Washington*

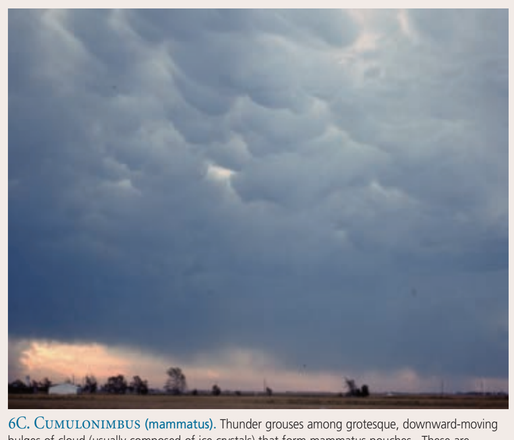
5C. Cumulus (congestus). No rainshaft is evident. Churning motions can usually be seen in dense and hard-appearing turrets such as these. The more obvious the churning motion, the stronger the updrafts in them, and the more rapidly such clouds might evolve into showers or thunderstorms. *Sonoma, California*

5D. Cumulonimbus (calvus). The upper half of this cloud is just starting to become fibrous as it converts to a Cumulonimbus capillatus (having an clearly fibrous top). The intense rainshaft distinguishes it from mere Cumulus. *Catalina, Arizona*

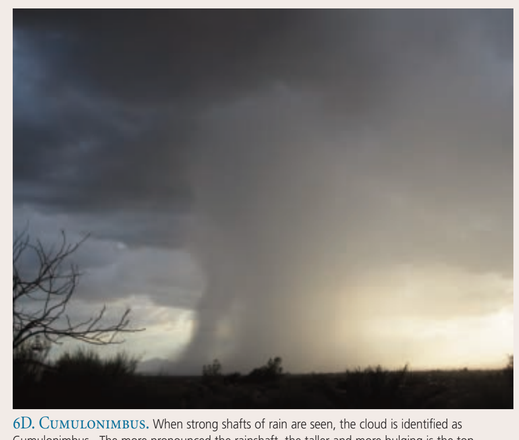


6A. Cumulonimbus (capillatus). Relatively shallow *Cumulonimbus* clouds like these often form after the passage of a cold front on the West Coast and over the Great Lakes in winter. The "capillatus" term is used when a fibrous appearance, usually due to ice, is clearly present. *Bodega Bay, California*

6B. Cumulonimbus (capillatus incus). Blossoming like a flower, the growth and expansion of this group of giant clouds unfolds aloft while hail is unleashed below. "Incus" means that an anvil, an outward spreading ice cloud, is present. *Catalina, Arizona*



6C. Cumulonimbus (mammatus). Thunder grouses among grotesque, downward-moving bulges of cloud (usually composed of ice crystals) that form mammatus pouches. These are found in the dissipating portions of thunderstorms. *Parkston, South Dakota*



6D. Cumulonimbus. When strong shafts of rain are seen, the cloud is identified as Cumulonimbus. The more pronounced the rainshaft, the taller and more bulging is the top. Tops here were more than 16 km (52,000 feet) ASL. *Catalina, Arizona*

When compared to the earth's size, the layer of atmosphere where nearly all clouds exist is no thicker than the leather cover on a softball. Within this fragile layer is a myriad of continuously evolving forms of that most ubiquitous and amazing of all substances, water. Water, unlike most substances on earth, exists in all three phases—gaseous, liquid, and solid—within the tiny range of atmospheric conditions found here on earth. Due to this versatility, clouds can suddenly appear and disappear, and precipitate, pelting us with rain and snow. While these events are commonplace to us, in a cosmic sense, they are nothing less than miraculous. And there is still considerable mystery. For example, it is not known how ice crystals form in clouds, and in many clouds there are far more of them than scientists had expected. The sky itself, where we can most easily appreciate these miracles, can be a joy, revealing something new everyday if we would but look.

This chart explores some of the most frequently seen shapes and forms of clouds in the sky, including the ten types (or genera), from *Cirrus* to *Stratus*, from the high to the low, and their most frequently observed species or varieties (e.g., fibratus, translucidus).

Cirrocumulus (1A), *Cirrus* (1B-1D), and *Cirrostratus* (2A) clouds are called "high clouds" and, except for most cases of *Cirrocumulus* clouds, are composed of ice crystals. Surprisingly, *Cirrus* and *Cirrostratus* clouds are rarely less than 1 km (3,300 feet) thick even when they show no shading. Their "bases", comprised of gently falling small ice crystals, range from 5 to 13 km (about 16,000 to 45,000 feet) above ground level (AGL). Widespread cirriform clouds (e.g., 2A) are often the forerunners of storms, particularly when they advance from a direction between southwest and northwest. They are the "smoke" from the "fire". This is because they often represent "blow-off" from the tops of deep, precipitating clouds upwind due to the stronger winds at the highest levels of the troposphere.

"Middle-level" clouds, *Altostratus* and *Altocumulus*, are shown in rows two and three. These clouds have bases that range from 2 to 7 km (about 6,600 to 24,000 feet) AGL. *Altostratus* clouds (2B) almost always cover much or all of the sky when they are present and usually have gray shading throughout. They are primarily composed of ice crystals and snowflakes. The dominance of ice crystals and snowflakes causes most *Altostratus* clouds to appear diffuse, with little detail (2B). This is because the concentrations of ice crystals and snowflakes in clouds are only about a hundredth to a thousandth that of cloud droplets. Hence, droplet clouds look very sharp-edged while ice crystal clouds, like *Cirrus* and *Altostratus* appear more fibrous or diffuse. *Altostratus* clouds are nearly always more than 2 km (6,600 feet) thick even when the sun can be seen through them. They are perhaps the surest sign that precipitation is imminent in middle and high latitudes. They show that the atmosphere is in gentle ascent over a great depth and over a wide area.

Altocumulus clouds (e.g., 2C-3D) are relatively thin, rarely more than 1 km (3,300 feet) thick, and are usually composed solely of tiny droplets only about one third the diameter of a human hair or smaller. They often appear soon after *Cirrus*, *Cirrostratus*, or *Altostratus* clouds have appeared. They, too often suggest a deterioration in weather, particularly lenticular forms.

Stratus (4A) and *Stratocumulus* (4B and 4C) are "low" clouds. *Stratus* clouds are nearly featureless and usually cover the entire sky. Storms are usually far away. They are featureless because there is little upward or downward motion in them.

Stratocumulus clouds, like *Stratus* clouds, also cover all or a large portions of the sky. Dark and light regions appear because of the embedded small cumulus-like clouds within them, and this is what distinguishes them from *Stratus* clouds. They are rarely more than 1 km thick, and for this reason, rarely precipitate. They tend to be darker looking overall at inland locales because the droplets in them are generally smaller and several times more numerous than in clouds over the oceans. This causes more of the sun's light to be reflected from their tops back into space.

Both *Stratus* and *Stratocumulus* clouds, except when their tops are colder than about –8°C (18°F), are composed solely of droplets. Heavy precipitation does not fall from them, though drizzle (mist-like rain) or light snow can fall. *Stratocumulus* and *Stratus* clouds together cover more of the earth's surface than any other type of cloud.

When it is raining or snowing steadily from widespread dark and gray clouds, you are experiencing the underside of *Nimbostratus* clouds (4D). These clouds (technically considered "middle-level" clouds), are generally greater than 3 km (10,000 feet) thick, and their tops often reach as high as those of *Cirrus* clouds. The tops of *Nimbostratus*, if you could strip away the bottom 90% of the cloud, often resembles the clouds shown in 1B and 2B, like solid layers of *Cirrus* uncinus or 3B, solid layers of Altocumulus clouds shedding virga.

The remaining photos (5A through 6D) show *Cumulus* and *Cumulonimbus* clouds. These clouds are distinguished from other clouds by the appreciable updrafts in their building regions, and appreciable downdrafts in their decaying regions. The updrafts in these clouds range from brief puffs of a meter or two per second (3-5 mph) in small *Cumulus* and weak *Cumulonimbus* clouds (5A and 5B), to more than 30 m/s (65 mph) in the most powerful thunderstorms (6B and 6C). Cumuliform clouds are avoided by pilots not only because of the turbulence, but also because of the heavy icing they can produce at below freezing temperatures. Icing occurs when cloud droplets, and in the larger clouds, raindrops, at below freezing temperatures impact and freeze on the airframe, thus disrupting the lift of the wing and adding drag.

Small and medium-sized *Cumulus* clouds (5A and 5B) are less than 2 km thick and generally composed of droplets. When their tops become colder than about –10°C (14°F), some ice crystals may form and snow flurries are possible in cold weather.

"Congestus" (5C) are the largest *Cumulus* clouds. They are greater than 2 km (6,600 feet) thick and often appear as wide as they are tall. Occasionally these clouds undergo a transition from a highly detailed, cauliflower look (5C) at cloud top to a smoother, cotton-candy appearance (5D). This subtle change, which can occur within 10 minutes, is associated with the development of ice crystals or raindrops and can sometimes precede the fall of a sharp shower from the cloud by a few minutes.

Cumulonimbus clouds are the "Tyrannosaurs" of the cloud world. The transition in the appearance of the tops of the cumulus clouds to a fibrous appearance, and the appearance of a strong rain shaft marks the moment when the cloud changes from a Cumulus congestus cloud to a *Cumulonimbus* cloud. The tallest *Cumulonimbus* clouds, those that form in tropical air (e.g., 6B through 6D), can have tops as high as 20 km (67,000 feet) ASL! Their "overshooting" tops penetrate into the stratosphere where they can inject aerosols drawn from near the earth's surface. They frequently combine into clusters of several to dozens of huge clouds that produce such destructive weather as lightning, flash floods, hail, damaging winds, and tornadoes. However, the destructive regions are small and beneficial rains from these clouds and their gently precipitating stratiform regions are usually far larger. Most of the rain that falls during the growing season in the United States is due to these kinds of cloud systems.

The smallest *Cumulonimbus* clouds form in polar air (see 6A) and can be less than 2-3 km thick. These kinds of *Cumulonimbus* clouds frequent the West Coast in the cooler half of the year following the passage of cold fronts. In these kinds of situations, clouds similar to those shown in 6A can be spawned almost continuously over and upwind of mountain ranges bringing surprisingly heavy snow and soft hail (called graupel). These "polar" *Cumulonimbus* clouds rarely produce lightning.

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